

ABSTRACT

The invention consists of an evaporative cooling device comprising one or more microchannels whose cross section is axially reduced to control the maximum capillary pressure differential between liquid and vapor phases. In one embodiment, the evaporation channels have a rectangular cross section that is reduced in width along a flow path. In another embodiment, channels of fixed width are patterned with an array of microfabricated post-like features such that the feature size and spacing are gradually reduced along the flow path. Other embodiments incorporate bilayer channels consisting of an upper cover plate having a pattern of slots or holes of axially decreasing size and a lower fluid flow layer having channel widths substantially greater than the characteristic microscale dimensions of the patterned cover plate. The small dimensions of the cover plate holes afford large capillary pressure differentials while the larger dimensions of the lower region reduce viscous flow resistance.